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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/051,228	01/22/2002	Thomas Alan Taylor	CS-21182	7993

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EXAMINER	
MCNEIL, JENNIFER C	
ART UNIT	**PAPER NUMBER**
1775	6

DATE MAILED: 04/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/051,228	TAYLOR ET AL.	
	Examiner	Art Unit	
	Jennifer McNeil	1775	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 May 2002* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-38* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4, 7-13,16-38* is/are rejected.

7)☒ Claim(s) *5,6,14 and 15* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) *4,5* .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Examiner's Suggestions

Claim 13, line 2 should have –layer-- after "zirconia-based".

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 2, 7, 11, 24, 25, 27-29, 33, 34, and 38 are rejected under 35 U.S.C. 102(b) as being anticipated by Chen et al (US 5,576,069). Chen teaches a zirconia coating on a metal substrate. The zirconia coating is deposited onto the substrate and is then laser-melted. This provides a coating with two layers, the first being the zirconia having cracks, and the second being the laser-remelted layer having no cracks (col. 3, lines 7-27).

Regarding claim 2, as shown in Figure 3, the cracks are vertical.

Regarding claim 7, the cracks extend from the first surface of the layer to the second surface.

Regarding claim 24, the zirconia may be stabilized with yttria (col. 3, lines 55-57).

Regarding claim 25, a bond coat may be present between the substrate and the coating (col. 3, lines 50-54).

Claim 27 is considered a method limitation for an article, and does not structurally define over the article of the prior art. However, Chen does teach heat treatment of the bond coat (col. 3, lines 50-54).

Regarding claims 29, and 34, the coating may be used on turbine engine components.

Claims 1, 2, 11, 22-25, 27-29, 33, 34, and 38 are rejected under 35 U.S.C. 102(b) as being anticipated by Nissley et al (US 6,102,656). Nissley teaches an abradable ceramic coating on a metal substrate. The coating includes a layer (18) that is deposited in a manner to produce vertical microcracks (col. 5, lines 7-11). Layer (20) is deposited on layer (18) and comprises a graded interlayer of zirconia. Layer (22) is deposited over layer (20) and is an abradable layer of YSZ (col. 6, lines 8-31). It is the examiner's position that the top layers (20) and (22) do not possess vertical microcracks as they are disclosed by Nissley as being present only in layer (18).

Regarding claim 2, as stated above, the microcracks are vertical.

Regarding claims 22 and 23, Nissley teaches a range of thickness for the ceramic layers (col. 4, lines 10-14; col. 6, lines 8-12, lines 52-55). The sum of the thickness of these three layer is within the ranges claimed by applicant.

Regarding claim 24, the zirconia may be stabilized.

Regarding claim 25, a bond coat may be present between the substrate and the coating.

Claim 27 is considered a method limitation for an article, and does not structurally define over the article of the prior art.

Regarding claims 29 and 34, the coating may be used on turbine engine components.

Claims 1, 2, 11, 19, 20, 24, 25, and 27-38 are rejected under 35 U.S.C. 102(e) as being anticipated by Good et al (US 6,358,002). Good teaches an air seal for a gas turbine engine. The air seal comprises a metal substrate and a ceramic coating. The ceramic coating may include a first dense

ceramic layer (16) having microcracks (col. 4, lines 52-65). An abradable ceramic layer (18) is deposited over layer (16). This abradable layer does not possess microcracks. Both ceramic layers may comprise zirconia.

Regarding claim 2, Good teaches that the cracks are formed in the manner taught by Taylor '433 (see PTO 892), which forms vertical cracks.

Regarding claims 19, and 20, the abradable top layer may have a porosity of 20-35 %, which would give a density of 65-80% (col. 5, lines 5-14).

Regarding claim 24, the zirconia may be stabilized with yttria.

Regarding claim 25, a bond coat may be present between the substrate and the coating.

Claim 27 is considered a method limitation for an article, and does not structurally define over the article of the prior art.

Regarding claims 29-32, and 34-37, the coating is applied to an air seal and is abradable.

Claims 1, 2, 11, 24, 28, 29, 33, 34, and 38 are rejected under 35 U.S.C. 102(e) as being anticipated by Graham et al (US 6,432,487). Graham teaches a process for applying a vertically cracked ceramic thermal barrier coating, and further includes an additional sacrificial outer layer. The vertically microcracked layers are too dense to abrade. The sacrificial coating is easier to remove and provides as an indicator to operators for thickness limits.

Regarding claim 2, as stated above, the microcracks are vertical.

Regarding claim 24, the layers may comprise zirconia stabilized with yttria.

Regarding claims 29 and 34, the coating may be used for turbine engine components.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chen et al (US 5,576,069) in view of Gupta et al (US 5,403,669). Chen teaches a zirconia coating on a bond coat as discussed above, but does not address the surface roughness of the bond coat. Gupta teaches a thermal barrier coating of a ceramic on a metal substrate. The ceramic coating may be zirconia, and is attached via a bond coat. The bond coat is applied with a surface roughness of 200-600 microinches, and serves as an anchor for the ceramic coating, which results in an article with resistance to spalling of the coating from underlying portions of the coating system. As it is taught by Gupta that a bond coat with a roughened surface serves to improve the resistance to spalling of the ceramic layer, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide a roughened surface to the bond coat of Chen to improve the spalling resistance of the overlying ceramic layer.

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nissley et al (6,102,656) in view of Gupta et al (US 5,403,669). Nissley teaches a zirconia coating on a bond coat as discussed above, but does not address the surface roughness of the bond coat. Gupta teaches a thermal barrier coating of a ceramic on a metal substrate. The ceramic coating may be zirconia, and is attached via a bond coat. The bond coat is applied with a surface roughness of 200-600 microinches, and serves as an anchor for the ceramic coating, which results in an article with resistance to spalling of the coating from underlying portions of the coating system. As it is taught by Gupta that a bond coat with a

roughened surface serves to improve the resistance to spalling of the ceramic layer, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide a roughened surface to the bond coat of Nissley to improve the spalling resistance of the overlying ceramic layer.

Claims 21-23, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Good et al (US 6,358,002) in view of Gupta et al (US 5,403,669). Good teaches a zirconia coating on a bond coat as discussed above, but does not address the surface roughness of the bond coat. Gupta teaches a thermal barrier coating of a ceramic on a metal substrate. The ceramic coating may be zirconia, and is attached via a bond coat. The bond coat is applied with a surface roughness of 200-600 microinches, and serves as an anchor for the ceramic coating, which results in an article with resistance to spalling of the coating from underlying portions of the coating system. As it is taught by Gupta that a bond coat with a roughened surface serves to improve the resistance to spalling of the ceramic layer, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide a roughened surface to the bond coat of Good to improve the spalling resistance of the overlying ceramic layer.

Regarding claim 21, while Good does not give a smaller range of porosity/density for the abradable coating, the range taught by Good fully encompasses applicant's range and it would have been obvious to one or ordinary skill in the art to select a porosity within the range taught by Good.

Regarding claims 22 and 23, Good does not specifically teach the combined range of the coatings, but the single coatings taken together approximate the range taught by applicants. Furthermore, it would have been obvious to one of ordinary skill to provide the layers at a thickness that would provide the desired corrosion resistance to the underlying substrate.

Claims 1-4, 7-13, 16-18, 22-25, and 27-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor et al (US 5,073,433) in view of Graham et al (US 6,432,487). Taylor teaches a thermal barrier coating for a metal substrate. The thermal barrier coating comprises zirconia

stabilized with yttria with a density greater than 88 % and a plurality of macrocracks homogeneously dispersed throughout the coating to improve its thermal fatigue resistance. Taylor does not teach an additional coating thereon that does not include macrocracks. Graham teaches that dense vertically cracked zirconia layers are too dense to abrade and provides a sacrificial layer on the dense layer that is easier to remove and serves as an indicator to operators for thickness limits. Both Graham and Taylor teach that the coatings are used in turbine engine components. It would have been obvious to one of ordinary skill to provide a sacrificial layer such as that of Graham, on the vertically cracked layer of Taylor to provide an indicator during use that the coating is reaching its thickness limits.

Regarding claim 2, the cracks of both Taylor and Graham are vertical.

Regarding claims 3, 9, 10, 12, 17, and 18, Taylor teaches that horizontal macrocracks may also be present, and may be 5-25 the average length of the vertical cracks (col. 3, lines 17-39).

Regarding claims 4 and 13, Taylor teaches that the macrocracked layer may be applied by multiple monolayers, each having cracks (col. 3, lines 1-10).

Regarding claim 7, the macrocracks may extend up to the length of the coating.

Regarding claims 8 and 16, there are at least 20 vertical macrocracks per linear inch, which converts to 50 per linear centimeter (col. 3, lines 5-10).

Regarding claims 22 ad 23, it would have been obvious to one of ordinary skill to provide the layers at a thickness that would provide the desired corrosion resistance to the underlying substrate.

Regarding claim 24, the zirconia may be stabilized by yttria.

Regarding claim 25, Taylor teaches the use of a bond coat between the substrate and the coating.

Claim 27 is considered a method limitation for an article, and does not structurally define over the article of the prior art.

Regarding claims 29-32, and 34-37, Taylor teaches that the coating may be used for turbine engine seals (col. 4, lines 48-50).

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Taylor et al (US 5,073,433) and Graham et al (US 6,432,487) and further in view of Gupta et al (US 5,403,669).

Taylor and Graham as combined above teach a turbine component with a vertically macrocracked layer and a sacrificial layer thereon. As taught by Taylor, a bond coat may be used between the substrate and the coating, but does not address the surface roughness of the bond coat. Gupta teaches a thermal barrier coating of a ceramic on a metal substrate. The ceramic coating may be zirconia, and is attached via a bond coat. The bond coat is applied with a surface roughness of 200-600 microinches, and serves as an anchor for the ceramic coating, which results in an article with resistance to spalling of the coating from underlying portions of the coating system. As it is taught by Gupta that a bond coat with a roughened surface serves to improve the resistance to spalling of the ceramic layer, it would have been obvious to one of ordinary skill in the art at the time of the invention to provide a roughened surface to the bond coat of Taylor to improve the spalling resistance of the overlying ceramic layer.

Allowable Subject Matter

Claims 5, 6, 14, and 15 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The prior art of Gray '586, Kojima '434, Farmer '539, Freling '262, and Wei '704 is considered related art.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer McNeil whose telephone number is 703-305-0553. The examiner can normally be reached on Monday through Friday, 9:30AM-6:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Deborah Jones can be reached on 703-308-3822. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Jennifer McNeil
Examiner
Art Unit 1775

JCM
April 18, 2003